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REPORT TO THE ANTI-DEBRIS ASSOCIATION
ON THE
EFFECT OF RESTRAINING DAMS
FOR THE
STATE OF CALIFORNIA.
BY
THE COMMISSIONER OF PUBLIC WORKS.

Printed at the State Printing Office, Sacramento.
A. J. JOHNSTON, Superintendent.

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SACRAMENTO, March 26, 1896.

To his Excellency JAMES H. BUDD, Governor of California:

DEAR SIR: The counties of Sacramento, Yolo, Sutter, Yuba, and Colusa, represented by their respective Boards of Supervisors in an organization known as the State Anti-Debris Association, whose object is to prevent injury by hydraulic mining to the navigable streams of Northern and Central California, and to adjacent farming lands, respectfully ask that you investigate, in accordance with law, through the office of the Commissioner of Public Works, whether the building of dams, as proposed by measures now pending in Congress, will result in the improvement of the rivers.

We would, in addition to the above, particularly ask that a report be made as to whether existing conditions require the building of dams as proposed as a plan of river improvement;

Whether the same, if built, would, under present conditions, result in injury to the rivers;

Whether the material they were once intending to impound has not already passed the point where such dams were intended to be built;

Whether it would be safe to allow hydraulic mining to be carried on behind these dams, from the standpoint of river preservation;

Whether, if built, successive dams would not have to be built if hydraulic mining were to be resumed.

The probable cost of same, and any other fact bearing upon the advisability of building dams for the purpose of improving the navigable rivers.

We would urge that a report be made as speedily as possible, as we consider the information desired of the utmost importance; and if any of the matters enumerated would require much time, we would ask that a report be made at once on the main points involved.

Respectfully yours,

STATE ANTI-DEBRIS ASSOCIATION.

J. M. MORRISON, President.

ROBERT COSNER, Secretary.

ROBERT T. DEVLIN, Attorney.

EXECUTIVE DEPARTMENT, STATE OF CALIFORNIA, |
March 26, 1896. |

Commissioner of Public Works:

Have made a careful and impartial investigation, and report as speedily as possible on the within.

JAMES H. BUDD, Governor.

REPORT

ON THE

EFFECT OF RESTRAINING DAMS.

To his Excellency JAMES H. BUDD, Governor of the State of California:

DEAR SIR: The communication addressed to you by the Anti-Debris Association, and by you referred to this office, was received in due time. With a view to complying with your direction, as far as practicable, Chief Engineer Price and Assistant M. A. Nurse, and myself, made an examination of Yuba River from Marysville to Smartsville, directing special attention to the site of the proposed dam at Daguerre Point. I herewith submit the report of the engineers. Your request was for a careful investigation. It was impossible to furnish all the information desired in the allotted time.

All the diligence, care, and thoroughness that was possible under the circumstances have been exercised.

Very respectfully, your obedient servant,

ED E. LEAKE,
Commissioner of Public Works.

To HON. E. E. LEAKE, Commissioner of Public Works:

SIR: Herewith we present our report upon the subject-matter contained in a communication signed by the President, Secretary, and Attorney of the State Anti-Debris Association, dated March 26, 1896, a copy of which is herewith transmitted.

We resolve the matter into the following questions, to wit:

1. Whether the building of dams, as proposed by measures now pending in Congress, will result in the improvement of the rivers.
2. Whether existing conditions require the building of dams as proposed, as a plan of river improvement.
3. Whether the same, if built, would, under present conditions, result in injury to the rivers.
4. Whether the material they were once intended to impound has not already passed the point where such dams were intended to be built.
5. Whether it would be safe to allow hydraulic mining to be carried on behind such dams, from the standpoint of river preservation.

6. Whether, if built, successive dams would not have to be built if hydraulic mining were to be resumed.

7. The probable cost of same, and any other fact bearing upon the advisability of building dams for the purpose of improving the navigable rivers.

The communication closes with the request that, if much time should be involved in the investigation, a report be made at once on the main points involved.

The communication was forwarded to Governor Budd, and was by him indorsed, as follows:

"Commissioner of Public Works: Have made a careful and impartial investigation, and report as speedily as possible on the within."

The Governor, evidently appreciating the vast interests involved in the solution of the questions propounded, desires a "careful and impartial investigation," and has by this procedure shown his desire to injure no person or persons, but to give equal justice to all interests involved in the solution of one of the most perplexing questions before the people of the State of California.

The answers to the various questions propounded are far-reaching, involving a knowledge of all the conditions that existed before hydraulic mining was commenced, as well as a minute detail of its progress and the effects it has produced in the many years that it has been permitted to continue, and the effects produced by its cessation in 1885, up to and including the present time.

They further involve the question of the effect of restraining dams, which seem to be the panacea offered by the hydraulic miner, and the ever-threatening avalanche to the farmer.

To give an intelligent and well-advised answer to any one of the questions propounded would require the collection of data in the field, which as yet has not, to our knowledge, been obtained. The only official data in this office is confined to the very excellent work of State Engineer William Ham. Hall and his assistants. So far as the work was prosecuted under that eminent engineer and his very eminent advisers, Colonel W. H. Mendell and James B. Eads, it is of the utmost importance. With the conclusion of the labors of the State Engineer the investigation of this question ceased, so far as the State is concerned. We therefore have no official data with which to frame intelligent answers to the questions asked, except as to the matter above mentioned.

To answer all the questions propounded would require a knowledge of the slopes of the various silt-bearing streams in their mountain reaches, the quantity of material now impounded in the various mountain gorges, and the slope obtained by virtue of the flow of this material. All of which is almost totally unknown, except so far as personal ob-

servation has been made with the eye, and not by accurate instrumental measurement.

I. The first question is rather indefinite in construction, not having stated whether it means the navigable or non-navigable streams; but we shall presume that it is intended to apply to navigable streams. As an abstract proposition, we may say that any impediment to the flow of silt or debris into a stream, which is *permanent*, will benefit or improve the river to the extent of its storing capacity. We are not advised as to the character of the construction of dams as proposed by measures now pending in Congress. At no point on the navigable streams of the State are we informed of the approach of any coarse mining debris into the navigable waters thereof. On the upper Sacramento River the gravel or coarse material has washed down stream as far as the town of Colusa; but, this not being a stream subjected to the effects of hydraulic mining, we shall presume that the question does not apply to this portion of the Sacramento River. It may be true that a portion of the heavy material from hydraulic mines has entered the valley on the upper portion of the Feather River; of this, however, we have no information at our command to either affirm or deny the proposition. So far as our observations extend, the greater quantity of material that has been deposited in the navigable streams consists of light sands and fine silt. Just how far this class of material can be restrained is a question which no engineer can answer without the data at hand showing the restraining powers of dams under the innumerable conditions that may govern the case. It was determined by Mr. Hall, in his observations of the Feather River in 1878, that not less than 90 per cent of the material in suspension in the waters of this river was deposited immediately upon the waters escaping into the Sutter Basin. But it must be remembered that these escaping waters came in contact with a larger surface of frictional area, the velocity was immediately checked, and the power of the water to hold the material in suspension was at once very materially destroyed. We may therefore conclude that a dam in its early history will impound the material just as long as it checks the velocity of the stream, and that it will cease to deposit matter in suspension in proportion to the increase of the velocity of the moving water. A dam will produce this effect if it has the power to retain its material until filled to the crest; but as soon as the dam is filled, then the waters deposit on an increasing incline until the incline becomes so steep as to render it impossible for either the material in suspension or that rolling on the bottom of the streams to remain on the incline, when it will move on to some point where the resistance of the power to move the material equals or exceeds the moving force or impact of the water. You will, therefore, perceive that the utility of dams will depend upon their storing capacity and the quantity of material required to be impounded.

II. We answer the second question by our previous statement and the facts set forth in the answer to the first interrogative.

III. In answer to the third question, we can see no reason why dams in themselves, properly constructed on the non-navigable rivers, would injure navigation or work an injury to the streams; *provided* they are not constructed in the valley regions. Any dam that would raise the bed of the river above the adjoining lands would probably result in new channel formations, which might divert the waters to valuable lands, and thereby result in great injury to drainage as well as to property rights.

IV. We presume that the fourth question has reference to the days of hydraulic mining. It would seem, from an examination of Mr. Hall's report, that he was dealing with an existing condition, and therefore suggested the best remedy his knowledge would direct for a remedy of the bad effect that might be produced by a continuation of hydraulic mining. The impounding ability of the various mountain streams having been exhausted at the time of his observations, he suggested the only plan for an increase of the reservoir capacity—namely, the construction of dams. Hydraulic mining was enjoined in the year 1885, and no extensive hydraulic mining has been permitted since that time. The result is, that during the successive winter seasons intervening between 1885 and the present time, a very considerable quantity of the material deposited in the higher reaches of the rivers has been moved down, approaching every year the gentler slopes of the watercourses. From information obtained from Mr. Meek, County Surveyor of Yuba County, we are authorized to say that no material change in the elevation of the Yuba River channel, between Marysville and Daguerre Point, has taken place in the past four years. Opinions are conflicting as to the location of mining detritus in the mountain streams, and as we have not had the opportunity to investigate the subject, we can give no reliable information upon the subject. The indications are that the greater quantity of the lighter material has already reached the valley, but just how much still remains in the streams above, to be attacked and moved down by the winter floods, we have not the necessary data to give a careful and impartial report.

V. From the standpoint of river preservation, we would say that any process of action, either natural or artificial, that will increase the matter in suspension in silt-bearing streams, will, in a corresponding degree, retard the scouring force of the water, and thereby injure the preservation of the capacity and navigability of the rivers. It is, therefore, a question that must be answered by the effect produced by dams as to whether hydraulic mining can be carried on behind them without injury

to the navigable streams. From our knowledge of the forces that are now acting on the navigable streams of the State of California, and the effects produced by floods, it is of the utmost importance that the rivers be assisted, in every manner possible, to scour out the already formidable silt deposits that are now in them.

VI. If hydraulic mining is to be resumed and the material restrained, undoubtedly a series of dams must be constructed, in order that any very material part of the detritus shall be restrained.

VII. It is impossible for us to give a reasonable estimate of the cost of constructing dams if hydraulic mining is to be resumed. No dam should be constructed that will not be permanent and lasting as time itself. The conditions surrounding the location will therefore govern the cost of construction. A repetition of the construction of dams upon the same plan as advised and built by State Engineer William Ham. Hall would, in our opinion, be far from meeting the requirements of the case, and should any be constructed the work should be under and by the advice of the best engineering skill. An intelligent and safe opinion as to the manner of constructing dams can only be given after a thorough survey and investigation of the conditions to be satisfied, which would require many months of labor in the field accumulating data at present not at hand. It is to be regretted that the necessary data has not been obtained, and herein lies the importance of a constant investigation of the subject, in order that a just and reasonable solution of the problem might at this time be presented.

Very respectfully submitted.

J. R. PRICE,
Chief Engineer to Commissioner of Public Works.

M. A. NURSE,
Assistant Engineer.



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